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V-22: Dual-Use Technology or Red Herring?

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ABSTRACT

Round, William H. (*National Defense University, Industrial College of the Armed Forces, Wash. D.C.*) ***V-22: Dual-Use Technology or Red Herring?*** *Academic year 1992-1993 Research project.* --- Discusses the validity of the V-22 as a potential dual-use technology in terms of the current dual-use definition. Program evaluations are discussed with regard to cost, affordability and need with respect to the delay-plagued weapons system. It is suggested that the V-22 has potential for greater utilization than a strictly military application. But, that opportunity is diminished by the current political, economical and international environment. An environment that is not condusive to the program's fruition unless extraordinary steps are undertaken.

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V-22: Dual-Use Technology or Red Herring?

INTRODUCTION

The V-22 Osprey has been a pawn in the battle between requirements and costs almost from its inception. The major factors with regard to the future of the V-22 are a combination of economic, political and military considerations. It is well known that a coalition of industry, congress and covertly the Marine Corps are on one side of the argument facing the administration and the Office of the Secretary of Defense (OSD) on the other. Each side has invoked arguments either for or against the program in the areas of economics (cost) and utilization (need) requirements.

The continuing slow growth of the U.S. economy coupled with the election of a new administration prone to emphasis on socially responsible programs and reduction of defense spending is foreboding. The number of new faces in the congress may help to dissolve legislative gridlock but the demise of the cold war dilutes military requirements in general and possibly the need for the V-22 in particular. These factors have merged to give V-22 proponents increased weight in their argument that the V-22 program will help cure domestic economic and social ills. Does the V-22 have a viable dual-use capability or is this argument a red herring? What are the broad implications for the military-industrial base in general and the current dual-use thrust in particular?

In light of the already proposed defense spending reduction and the high probably of additional future reductions, numerous proposals on how to preserve the U.S. Defense industry and its technological superiority have been debated. In some

instances, specific action has been initiated by the Department of Defense (DoD) to protect this lead. First and foremost of these actions was the development of the new DoD acquisition strategy. The new acquisition strategy was announced in the spring of 1992 by Deputy Defense Secretary Donald J. Atwood. The initial proposal, which was long on rhetoric but short on details, quickly drew fire from industry and congressional critics alike. Defense officials now are rummaging through the wreckage, looking to find common ground among counterproposals that offer differing perspectives on ways to sustain the nation's defense industry base as military spending declines.[1] Initial military response was as critical. The Pentagon's new acquisition strategy of developing new technologies and putting them on the shelf could be prohibitively costly and erode not only the industrial base but the nation's science and technology base as well, a senior Air Force official said.[2]

Some of the common areas considered in the effort to keep the defense industrial complex from falling behind the world in technological development include the dual technology approach and technology transfer. While the DoD may now specifically be making these efforts a part of its official approach to acquisition, the defense related industries have attempted to use the dual technology approach and technology transfer with varying degrees of success for some time. A survey of top ranking executives at 125 defense companies indicates the majority plan to study or pursue commercial markets during the next five years. Nearly half of the commercial ventures attempted by defense companies since 1986 have been a success.[3] These

successes have been predominately with technology transfer vice a dual technology approach.

Conversely, there have been numerous arguments against the integration of civilian and military technologies and production, the dual use approach. Some maintain that existing companies with both a defense side and a commercial side are at too great an advantage over pure commercial organizations when it comes to bidding on defense particular projects. Therefore, the strictly commercial organizations have generally shunned involvement with defense related opportunities. If DoD shifted to a more "market economy" approach, those disadvantages might disappear. Unfortunately, in the past, most attempts at integration took place during periods of dramatic defense cutbacks. Opportunities for long-term planning were eliminated and the gradual transition necessary for a successful integration effort was not possible.[4] This identical situation exists today.

Now may be the right time for the United States to shift toward an integrated commercial and military industrial environment. The two most persuasive reasons are (1) the existing problems (and the growing awareness of these problems) in the defense industrial base and (2) the decline in the country's international industrial competitiveness, and the resulting trade inbalances. The latter has had a serious impact on the economy and has become such a high-visibility political issue that many, particularly in Congress, are searching for ways to encourage a reversal of the downward trend.[5]

Proponents of the V-22 looking to marshal any and all support for their cause have long espoused the dual technology/transfer implications of the program. Can the V-22 program development be cited as an example supporting the dual technology\ technology transfer approach to defense acquisition and therefore be affordable? Or, is the approach a coalition ploy combining congressional pork with the profit incentive of Bell-Boeing?

Forces opposing the V-22 program must look well beyond the simplistic arguments of affordability and requirement. They must back off of the parochial issues and look at the program as a national asset. There is an opportunity to catch many fish using a single bait! That opportunity is time critical, both from a particular technology standpoint and from a national security standpoint. To make the most of the opportunity will require compromise and cooperation at all levels.

WHAT IS "DUAL-USE" TECHNOLOGY?

Dual-use technologies have become prominent in the quest for defense conversion. In fact, Congress provided $200 million for various dual-use technology programs for 1993. "Dual-use" means having defense and commercial application, whether as a technology, process, or product.

Dual-use technology refers to fields of research and development that have potential application to both defense and commercial production. Some technologies are important for both DoD and commercial applications. Imaging-sensor technology, for example, has broad applications in surveillance systems, video cameras, and robot vision systems that find both military and commercial uses. In fact, at the generic level, most of today's important technologies can be considered dual use.

Dual-use processes are those that can be used in the manufacture of both defense and commercial products, such as soldering, process control, and computer-aided design. For defense acquisition, these processes are frequently tied to

military standards that may make them defense-unique, resulting in the segregation of defense and commercial production.

Dual-use products are items used by both military and commercial customers. Notable examples are global positioning systems used for navigation, aircraft engines, and most medical and safety equipment used by DoD. Some modified commercial equipment are similar enough to those used by the military to be considered dual-use. Some examples are the Air Force's KC-10A (McDonnel-Douglas DC-10) and the Army's light cargo vehicle, the CUCV (Chevy Blazer). DoD's ability to buy dual-use products is limited by the requirements of military specifications and standards and by the degree which commercial firms are willing to comply with defense purchasing requirements.[6]

How can DoD benefit?

The DoD is attempting to benefit from dual-use by rethinking the way it goes about its mission of national security especially in light of the current economic and world environment. A major consideration is DoD's approach to acquisition.

The new acquisition approach is a response to what some experts claim is a need to redo completely the way DoD does its business. Specifically, Senator Jeff Bingaman, Dr. Jacques Gansler and others are now calling for a revolutionary strategy that marries commercial and military technology goals to maintain military strength in an era of budget decline.[7]

Support for a dramatic change in the way the U.S. can maintain or enhance its status in the world with respect to its position of military technological superiority has come from all directions. Adding fuel to the fire of proponents for a change is a collection of findings made by the Office of Technology Assessment (OTA) in a report published in 1989. After studying several cases related to maintaining a defense technology base the OTA found in each of the cases reviewed, barriers exist between the military and civilian sectors of the economy. These barriers are due largely to

differences in organization, administration, and the business practices, rather than to differences in the technologies themselves. Some pertinent findings from the study:

> 1. Two relatively separate economic sectors have evolved in the post-World War II period, one military and the other commercial. Business practices in the two diverge significantly, and substantial barriers impede the transfer of advanced technology between one sector and the other.
>
> 2. The United States is failing to develop and/or maintain a competitive commercial base for some technologies that are important or even essential to military procurement. It is likely that DoD either will have to turn increasingly to foreign suppliers to achieve or maintain state-of-the-art capacities in such areas, or will pay a high price to maintain in-house capacities.
>
> 3. Long-standing industrial and trade policies may have to be reformed if the United States is to achieve and/or maintain world-class industrial capacity in support of certain essential dual-use technologies.
>
> 4. Due to the magnitude of the investment that is required to create advanced technological capability in a number of critical areas, DoD cannot afford to finance advanced technology and product development across the full spectrum of technologies that are important to the military. Instead, it must rely on innovation and R&D in the civilian sector to pull some technologies forward.
>
> 5. Congressional attempts to reform DoD and the defense industries may be inappropriately aimed at fixing an archaic military-industrial structure that is out of step with a world economy radically transformed by intense international competition.
>
> 6. A company can organize to do business in either the military or in the civilian sector of a high-technology industry, but it is extremely difficult to do both under one administrative roof.
>
> 7. Antitrust policy and a rigid regulatory framework in

some high-technology areas is adversely affecting the competitiveness of the U. S. industry.[8]

While this is not a conclusive list of the myriad of findings that OTA developed, it certainly sets the stage for arguments put forward by the V-22 proponents.

Why Dual Technology?

The dual-use debate, which came to life a few years ago, has been strongly stimulated by the end of the Cold War and the prospects of prolonged defense spending cuts. As it becomes increasingly expensive to sustain military R&D and production lines for decreasing numbers of end-products such as fighter aircraft and tanks, one part of the debate focuses on the question of the extent to which dual-use industries can contribute to a sustainable military-industrial prepardness.[9]

The benefits of dual-use are similar to those of integrating commercial and military manufacturing. Increasing the use of dual-use technologies, processes, and products would increase the size of the industrial base upon which DoD can draw, allow DoD to take advantage of the state of the art in commercial products, and help generate a greater return on Federal research investments. Dual-use could also save DoD money since increasing a company's business base would lower overhead costs on DoD purchases.[10]

Clearly, many of the broad problems faced by the U.S. defense industrial base, such as the disappearance of the lower tiers (sub contractors.. my definition), the growing foreign dependency, the peacetime inefficiency, and the incapacity for production surges in periods of crisis could be solved by reversing the current trends

towards increasing separation of the defense industry from its civilian counterpart and turning toward far more integration of defense and civilian technologies and industries.[11]

So what is the idea behind pushing for an approach such as dual-use technology to ensure the continuing world dominance of U.S. military and commercial aviation? The aforementioned experts maintain this strategy "provides the best hope for addressing the problems of the defense industrial base; promises significant cost savings to the DoD at a time of budgetary crisis; ensures adequate surge capabilities to meet emergency military requirements; and, at the same time, strengthens the science and technology base in the United States."[12]

Technology Transfer

Imbedded in the dual technology approach to future military and civilian needs is the incipient technology transfer. Some of the technologies have been deemed as critical to the U.S. national security. Concern over the perceived problems in the technology base of both defense and civilian sectors has led to a number of recent initiatives. In fact, over the last few years, there has been numerous occasions where Congress has requested a list of "critical technologies" from DoD and the Department of Commerce (DoC). The White House Office of Science and Technology along with DoD and DoC have published lists in compliance with the Congressional requests. The composite list published by the Office of Science and Technology Policy is included as Appendix A.

In May of 1991, Dr. Herzfeld put forward the Pentagon's revised list of critical technologies. In that plan he told Congress that the Pentagon planned to develop and

fund 21 "critical technologies" needed to guard the nation against "rapid diffusion of lethal technologies to regional powers, including potentially unpredictable and ruthless regimes."[13] Since that time, the list has been embodied into 7 technological thrust areas reflecting the Pentagon's changing strategy. According to Dr. Victor Reis, the Defense Department Director of Research and Engineering, these "thrust" areas reflect the President's National Security Strategy. The thrust areas are presented in Appendix B.

Outlining the principles of the new science and technology strategy, Reis said that strategic management of the process starts at the top and you "identify what you want from your investment, identify real world constraints and drivers, define a set of needed defense capabilities, and selectively invest in those technologies that show the best promise of needed capabilities."[14]

An interesting argument can be made after reviewing the lists of both DoD, DoC and the Office of Science and Technology. Of the 21 technologies listed by the DoD, only 5 can not be found on the DoC list of emerging technologies. From the complete lists in appendix A, the 5 sole defense related technologies are:

high energy materials

hypervelocity projectiles

pulsed power

signature control

weapons system environment

Having such technological commonality need not imply that the applications are common. But, it does imply that congruence between military and commercial

technology requirements is substantial and that there should be major opportunities to work dual-use technologies cooperatively.[15] Without getting into specific analysis, this position would seem to play into the hands of the V-22 advocates.

The fact that the Critical Technology Lists of the Departments of Commerce and Defense have merged in the past years shows that the military acquisition agencies need to change cultural-based decisions regarding military equipment and the development of such equipment. The Services must recognize the applicability of dual-use technologies and the benefits of using these commercial-based items in military systems.[16] The reciprocal approach of commercial use of military equipment must also be kept in mind.

Regardless, the products or processes that precipitate from previously defense specific R & D would naturally have to migrate to the commercial side of any dual technology programs. This would obviously have some national security implications. Though perhaps not to the level espoused by Dr. Herzfeld. When the product or process is commercialized, the DoD has made every effort the prevent security related technology from reaching the wrong hands. In fact, this is one of the primary reasons a separate defense industry evolved. Moreover, transitioning from a secretive, defense-driven environment and culture characterized by innovative ideas and exotic hardware -- what some call "technology push -- to a "market-pull" orientation that improves U.S. competitiveness is often a wrenching process.[17]

Technology transfer between the military and the civil sector has been an enabling force behind the remarkable success of civil aviation in this century.[18] But, the

process still raises questions about the security risk involved. The recently proposed McDonnell Douglas-Taiwanese agreement that would result in the sale of 40% of its commercial aircraft operations to Taiwan Aerospace Corp. is an example. Congress requested a review of the proposal by industry analysts. The witnesses, drawn from a cross-section of the industry, generally agreed that current safeguards would prevent the Taiwanese or other potential Asian investors from gaining access to vital U.S. aerospace technology.[19] Perhaps the Congress was convinced but recent allegations that Israel violated technology transfer regulations by transferring Patriot missile technology to China have arisen to poison the water. The allegation arose at the same time the State Dept. was investigating reports that a number of countries, including Israel, violated U.S. technology transfer regulations.[20]

The other side of the argument is offered by some of the "Black World" engineers. Opponents of the status-quo, keep-it-all-classified school see a different "priority" emerging. These engineers, scientists, technicians and aircraft mechanics believe that U.S. *economic* national security is more at risk today than military security. They maintain one way to combat economic threats to each citizen's standard of living and prosperity is to release some of the secret technology already developed at taxpayer expense.[21]

The idea of an official endorsement to this approach of technology transfer might be new in regard to a specific strategy, but the natural crossflow of technology between the military and the civil sector or vice versa is not. The classic aviation technology transfer example began in the mid-1940's, when B-47 bomber

technology (podded engines, swept wings, aerolasticstructure) was incorporated into the B-52 design of the early 1950's.

B-52 components, including J-57 engines and wing concepts, were utilized in a civil-developed prototype aircraft, the Boeing 367-80. The 367-80 then provided the foundation for the KC-135 military tanker, leading to the development of the Boeing 707. The DC-8 was developed from a similar path based on B-52 technology.[22]

My discussion until this point has centered on what I feel would justify a supporting argument for the production of the V-22. That is if all the strategies and approaches to technological development were in place. Unfortunately they are not. In the next section I will unravel the development history of the V-22.

THE V-22: A REAL OSPREY OR LAME DUCK?

Development

The aircraft known today as the V-22 is actually the result of a continuing evolution in designs resulting from an age-old desire of mankind to perfect vertical flight. Long before the Wright brothers flew at KittyHawk, many attempts to get airborne vertically were tried. Once powered flight was attained, it was only natural that vertical flight would evolve.

The Marine Corps demonstrated the concept of vertical assault as a successful adjunct to the amphibious landing in 1948. The aircraft used was a Sikorsky HO3S-1. It was a single piloted, single rotor helicopter capable of carrying 3 passengers. As the capabilities of potential Marine Corps adversaries improved, the requirement for more

capable "vertical assault" aircraft grew also. In 1956, each of the U.S. armed services began developing its own requirements for second-generation replacement aircraft. In 1958, recognizing the need for improvements in vertical-flight aircraft, the Department of Defense directed the Navy to conduct a study on the feasibility of a vertical takeoff and landing (VTOL) aircraft that would satisfy the requirements of all the armed services. The study's results indicated that such an aircraft - a compound helicopter, in this case - was feasible for all four services' medium lift requirements.[23] Several designs were advanced, but differing directions with regard to equipment upgrades and capabilities soon dissolved any effort to build a joint aircraft. The Marine Corps stood alone in its quest for a VTOL aircraft. However, economies of scale led to a continuing improvement of the basic helicopter design instead of an advancement in the VTOL technology.

By the early 80's, the existing helicopter technology was not keeping up with the evolution of the worldwide threat. Concerned with replacing specific aircraft in their inventories, the services established their own mission requirements for the new aircraft: the Marine Corps wanted a CH-46 replacement for medium assault support; the Army wanted a medium-lift aircraft that could also be used for aeromedical evacuation; the Navy was interested primarily in a combat search and rescue aircraft; and the Air Force wanted a long-range special operations aircraft that would also be capable of combat search and rescue.[24]

From this combination of requirements, the Advanced Vertical Lift Aircraft (JVX) was birthed. Specifically, the Joint Services Operational Requirement (JSOR) for

the JVX stated "JVX must be fully capable of conducting worldwide operations in conventional, unconventional, and contingency combat situations, including tactical Nuclear, Biological, and Chemical (NBC) warfare conditions. JVX will operate within the envelope of air, naval, and land weapon systems with the most severe threat to friendly aircraft being posed by the Soviet Union and its Warsaw Pact allies. This advanced vertical lift aircraft, with multi-service applications in the diversified mission areas of amphibious and land warfare, must survive a broad spectrum of land and sea-based weapons with their associated target acquisition subsystems. The JVX will supplant existing types and models in those older aircraft's basic mission roles. Current operational and organizational concepts are not expected to be altered except where it becomes advisable to take advantage of the JVX's enhanced mission capabilities and multi-service application."[25]

Interestingly, the initial design proposals were similar to those considered in 1960:

~ *Lift Fan.* Capable of high speeds, but burned more fuel than other configurations.

~ *Compound helicopter (advancing blade concept).* Two counter-rotating main rotor blades were mounted on a single mast to overcome the adverse effect of retreating blade stall; could not meet the stated speed requirement.

~ *Improved conventional helicopter.* While helicopters were improving,

they still could still not meet the speed, range, and maneuvering requirements.

~ *Tiltrotor.* The only technology that could perform all the missions using a common airframe with varying mission equipment.[26]

The Army was given the job of executive service and a formal joint program for the JVX was established in December 1981.

The specific lineage of the V-22 (the designation of the JVX) can be traced to the Bell D266 project. On 13 April 1973, Bell was awarded a contract from NASA Ames and the U. S. Army Air Mobility Research and Development Laboratory to build two of their Model 301 Research Tiltrotor aircraft, under the military designation XV-15, over a four year programme.[27] Events of merit during the development of the XV-15 follow:

~ First hovered on 3 May 1977

~ First transition from vertical to aerodynamic flight 24 July 1979

~ Set unofficial speed record for rotorcraft 17 June 1980

~ Then Secretary of the Navy John Lehman flew in the XV-15 in 1981

~ Completed seaboard trials August 1982

During the XV-15 programme, Bell joined forces with Boeing Vertol to submit a tiltrotor design in the Joint Services Advanced Vertical Lift Aircraft (JVX) programme.[28]

Until this point in the unfolding saga of the V-22 Osprey, the program seemed to be developing in much the same way as many previous aircraft did. An independent civilian development program produced the technology and a demonstrator. The technology filled a weapons systems requirement void for a multiservice mission.

Additionally, the specific tiltrotor technology appeared to be a leading candidate for selection as the weapons system of choice. It would seem at this juncture, the possibility for growth and acceptance in the military was a sure thing and the opportunities based on military exposure for further expansion into the commercial field looked very promising. It is now approaching ten years since the initial request for proposals were released to the aircraft industry and the program is mired in a cost, requirement, and application controversy that may leave the technology stranded short of a true production capability. What went wrong, why hasn't the commercial world jumped on the project in an effort to reduce reliance on space consuming conventional runways or meld the technology into a domicile building feeder airline mission? In the following discussion, I will play out the saga of the V-22 in regard to the dual technology approach. Also, I will determine if the Osprey fills the bill.

V-22: The Military Side.

Programatically, things started downhill from the very beginning. Again, competing priorities and strained fiscal resources had an early impact. The Army, previously mentioned as the executive service, bowed out of the program and handed the reins to the Navy. The Air Force also impacted the program when they reduced their requirements. By 1986, the total number of aircraft in the proposed buy had dwindled to a much smaller number of aircraft than the original concept called for.

Regardless, in 1986, the Naval Air Systems Command awarded a contract to the only competitor who bid on the V-22 project. The Bell-Boeing team was awarded a

$1.75 billion contract for the full-scale development of the V-22. The contract was for six prototype aircraft and three ground test vehicles. The contract was also firm-fixed price. That caused some concern for Bell-Boeing as the overall number of projected production aircraft had dwindled.

Typical new aircraft development problems emerged during the full scale production efforts. Vibration and weight problems added to production delays and the decrease in total numbers drove the individual aircraft costs up. In search of cheaper alternatives, Secretary of the Navy Dick Cheney sought to cancel or cutback the program in 1989. While the Pentagon tried to trim the V-22 program, Congress put it back in the budget. Local districts' desires for contracts were aided by proponents of commercial aviation and airport management interests in a short-takeoff craft. Why not pursue research on that aspect apart from developing a weapon whose mission is to drop Marines so far inland that they would be beyond the range of supportive naval gunfire and artillery?[29] This argument put forward by Pascall and Lamson in Beyond Guns & Butter attacks the operational requirement while supporting the affordability and dual technology standpoint by recognizing the potential commercial use of the mature tiltrotor technology.

Congress, after numerous studies, was convinced the V-22 would be an affordable technology. They directed DoD to keep the V-22 program in the budget and plan on a reduced production rate upon completion of the testing program. The Bell-Boeing V-22 Osprey tiltrotor aircraft program continues hanging on to life: in November 1991 the U. S. Congress voted to authorize $625 million in new program

monies for Fiscal Year 1992 as well as adding $365 million in prior year funds from fiscal years 1989 and 1991. This total of $990 million now permits Bell/Boeing to move forward on building "production-representative" aircraft under engineering and manufacturing development (EMD) which still falls under the heading of R&D.[30] Despite the obvious intentions of Congress to get the V-22 program on track, the actual contract for the EMD aircraft between NAVAIR and Bell Boeing was not signed until 22 October 1992. This phase will result in four new production representative aircraft, plus the modification of two existing V-22s for flight testing.[31]

The Commercial Story

The tiltrotor technology has been in existence for some time. In that time there has been an evolutionary and varied level of progress development. Several federal agencies in addition to industry are now or have at some time in the past been involved with the tiltrotor program. The National Aeronautics and Space Administration (NASA), the U. S. Army, U. S. Navy, and industry have been pursuing research on tiltrotor aircraft technology over the last 25 years. The goal, according to the FAA, has been the validation of a configuration approach that promised helicopter - like hover efficiency with turboprop cruise speed and range.[32]

The NASA effort to bring tiltrotor technology to maturation consists of numerous studies on their own and a team effort with the Navy. One of the most supportive studies was released in 1983 from the NASA Ames Research Center. It implied that a civil version of the JVX tilt rotor military aircraft offers high potential for national benefits and marketing opportunities in the early 21st century.[33] Subsequently, NASA and the

Navy officially joined the technology development through a memorandum of agreement and the establishment of a joint research team. This happened in the 1987-1988 timeframe. Together, they developed a program plan and a list of prioritized technology tasks that would pay big dividends to the program. NASA stressed the Navy must establish a lead in advanced tiltrotor technology with the expected introduction of the V-22 for capability enhancements on the current system as well as advanced conceptual designs for the next generation systems and subsystems. Utilizing the existing NASA expertise, ongoing research and facilities that are oriented toward tiltrotor, the Navy will be able to leverage its tasks and funding to produce a significantly enhanced product for future Department of Defense (DOD) applications. In addition, the NASA tiltrotor technology base will be expanded through funding and cooperative (Navy/NASA) efforts that will be beneficial to military as well as the civil applications.[34] All the additional R&D to advance the technology was nice. The only thing missing in this picture is funding for support of production!

The FAA while being an active supporter of the program can only help by being vocal and by presenting studies showing what the application of tiltrotor technology can do for the civil applications. Irrespective of the costs, all the studies point to the fact the concept could have a major impact on the way commercial aviation develops in the future and how the tiltrotor can help relieve airway congestion. Despite the findings that the tiltrotor technology would make a major impact, the FAA had several concerns about the V-22 program. This is especially true as the V-22s' future vacilated back and forth in the continuing showdown between Congress and DoD. In 1990, the FAA

Administrator requested that the Research, Engineering and Development Advisory Committee (of the FAA) form a subcommittee to advise the FAA on various areas of tiltrotor technology and the application of this new technology to civil aviation.[35] The June 26, 1990, report contained several findings and recommendations that really summarize some of the V-22 program problems. The subcommittee found that "The military-developed technology still needs to be tailored to commercial requirements." Additionally, the subcommittee determined "Potential future buyers and operators of civil tiltrotor have a 'show me' attitude, and must be convinced the technology and concept is viable before they will commit funds and place orders for aircraft."[36] Again, the support was wholehearted. The only thing the FAA could not do for the program was fund or help with funding production efforts.

Numerous studies about the impact and economics of the tiltrotor in the commercial market have been undertaken. Most of the studies are in response to unfounded criticisms. There are always detractors to new ideas: those with parochial interests; those whose thinking is more guided by past experience than by future opportunities; those who insist that anything new be measured within certain standards; those who simply fail to understand or are uninformed find various criticisms more readily than they find workable solutions.[37] Typical questions or statements the program has had to defend or explain are:

"It won't work" - ignorance of the technology

"Tiltrotors will damage the Commuter Fixed Wing market" - parochialism

"Its too complex for commercial service" - past experience

"It won't be allowed to operate in cities" - lack of education

"What about costs?" - lacking definition of real costs.

Preliminary analysis of actual operating cost in the FAA/NASA/DoD economic analysis examined a 230 mile trip. In rough terms, the tiltrotor trip cost is projected to be $22 more per seat than a turboprop, but $36 less per seat than a helicopter. Consider, however, that each element in an air trip has a cost. When ground transportation cost is included, the total portal to portal cost will most often be in favor of the tiltrotor. This factor closes the cost loop! On a portal to portal trip of under 500 miles, given properly situated vertiports, trip time will always favor a tiltrotor. Looking at the question in this light, if these facts hold true, it's a dynamite market![38] Especially in high density areas such as Japan, Europe or South West Asia, where the concept has high export potential.

The Foreign Factor

With respect to the V-22 situation, the most potential for damage to U.S. national security interests is the appeal of the tiltrotor technology to foreign interests. The U.S. lead over foreign tiltrotor advances is in jeopardy for several reasons. The primary reason is the foreign approach to military/civil industrial integration. An additional hurdle is the foreign subsidized and/or consortium approach to investment in the aircraft industry.

A recent OTA assessment of international arms cooperation noted that foreign firms in Europe and Japan are structured to make much more use of their civilian

capabilities. This structure has resulted, at least in part, from different approaches to acquisition and accountability.[39]

French civil-military integration is in sharp contrast to the situation in the United States, where specialized auditing and accounting rules and process specifications create high barriers between civil and military production, forcing diversified defense contractors to establish separate commercial and military divisions.

Another important factor is that the French Government imposes no legal, regulatory, or accounting barriers to combining civil and military activities in the same facilities (other than security restrictions and military specifications). SNECMA (a French aircraft industry organization), for example, plans to use the core of the M88 aero-engine being developed for the *Rafale* fighter as the basis for a new civil aero-engine, the M123, that will power a 100-seat passenger aircraft.[40]

The Japanese have always had a reputation of being aggressive in the global markets. In the commercial aircraft industry, the trend remains. They have demonstrated a significant interest in technologies and vehicles that provide tiltrotor-type potential and capability. One expression of the Japanese interest in this class of technology is the formation by Japan's Ishida Group of a company in the U.S. to develop a tiltwing aircraft to serve essentially the same market as the tiltrotor. The Ishida-formed company is located in the Dallas-Fort Worth area and will be able to take maximum advantage of the tiltrotor talent base developed by Bell Helicopter Textron. They will have the option to compete in the market with a tiltwing design or assume the lead in tiltrotor production if the U.S. defaults.[41] Currently the Japanese tact has been

an attempt to get into the market with a tiltwing approach. The TW-68 Tiltwing is the goal of the Ishida Group. They have constructed a facility in Texas and are moving closer to production possibilities by searching for partners. Shoichi Sugiyama, vice president of administration for Ishida Aerospace Research Inc., the Fort Worth, Texas, company tasked with the developing the tiltwing, said $40 million has been spent on the program thus far, and another $400 to $450 million may be needed to achieve FAA certification, targeted for 1998. Ishida chairman Taiichi Ishida is determined to maintain the Fort Worth facility, but "he's not committed to going to production alone," Sugiyama told Rotor & Wing International. "That's why we're looking for a partner."[42] The point here is not that they may be having trouble with the program, but, that they undertook the challenge to attempt to fill a market niche on their own. Typical of the Japanese approach!

If the U.S. government funding for the V-22 should cease, it seems likely the U.S. manufacturers will enter serious discussions with the Japanese for funding support for a civil aircraft.[43]

Sales of aircraft industry products abroad are a bright spot in otherwise dismal foreign trade statistics. Despite the tenth consecutive trade deficit for U.S. exports in 1985 -- and a record at $136.6 billion -- the U.S. aircraft industry continued to enjoy a positive balance with its trading partners.[44] The U.S. aircraft industry continues to play an important role in the economic health of the nation. Since the beginning of the decade, however, foreign aircraft manufacturers have increasingly challenged producers both at home and abroad. The development of tiltrotor aircraft, however,

promises to stimulate the domestic industry. Additionally, the export potential of such an aircraft could help the industry recover lost market share abroad.[45]

The increasing trend of procuring products in foreign countries and in foreign-owned U.S. facilities is generating concern within the Federal government , the private sector, and academe. Many agree that some U.S. industries, including defense industries, are bound to become increasingly international in character and that it would be futile to oppose this globalization process. The concern is that market control over some products critical to our defense needs is becoming concentrated in the hands of a few foreign countries.

Because foreign companies (and their U.S.-located operations) are subject to regulation by their home countries, they might be encouraged or required by those countries to take actions inconsistent with U.S. national security interests or specific political actions. The essential issue is that all nations will exercise sovereignty over their economies and the national interests of our friends and allies will not always be consistent with those of the U.S.[46] This by itself should be reason enough for the U.S. to take a hard look at its approach to maintaining critical technology leadership and the preserving of industrial capability. The V-22 program offers an opportunity to do just that.

The Coalition

Congress did not reach the decision to pursue the V-22 project because they had some divine guidance that tiltrotor technology was the wave of the future. The fact that the V-22 program has some type of manufacturing or logistical base in 47 states

was important but certainly not the sole decision criteria. The fact that DoD had already invested $2.5 billion was also a consideration. The staying power of the V-22 program can be contributed to a strong coalition from a number of sources.

Initially, the opposition, anchored by DoD and the administration seemed immovable. Numerous options developed for alternative strategies always had the cost figures to back up their argument. Program supporters argued that "alternative strategies" would only cost less if the mission or operational requirements were changed from the original concept. When original or more realistic downsized requirements were maintained the old cost argument was replaced by the up front argument of affordibility. Program supporters just would not give up as the coalition gained in strength by appealing to more and more groups such as those that feared Japanese commercial interest in the technology. The Marine Corps officially supported the DoD position. However, well organized and well respected groups supporting the Marine Corps attacked the problem unofficially. Knowing the argument about requirements was moot and that Congress had stated they would be the ones to determine if the program was affordable, the supporters utilized numerous angles of attack to get their point across. With the constant tug of war between each side of the argument, the program decision question seemed to have developed a mind of its own.

The make-up of the V-22 support coalition consists of numerous members of congress, industry, other federal agencies and special interest groups. The FAA and NASA have been ardent supporters of the tiltrotor technology from the beginning and

their efforts I have previously covered. The major problem faced by any non-DoD federal agencies such as FAA and NASA is lack of specific R&D or production funding.

Secretary of Defense Dick Cheney failed to put the V-22 in the appropriation request for FY-93 but Congress overcame the opposition as the number of tiltrotor supporters continues to grow. Continued development of the V-22, AH-64 Apache modernization, and other helicopter programs received welcome support in the $254-billion, FY-93 U.S. defense bill passed by Congress and signed by the President in November of 1992.

Despite the July 20 crash, the Osprey program won approval for the full congressional authorization of $755 million which, in addition to prior-year funds, provides for the manufacture of additional, production-representative prototypes. Most importantly, it will release funding for production required items without officially approving production go ahead. However, Congress also provided authorization language that not more than 50% of FY93 funds may be spent until it receives a full report on the accident.[47]

In the closing days of the 102nd Congress, two pieces of legislation bolstered the rotorcraft industry's hopes of continued support from Congress for a civil V-22 aircraft.

One key move was the passage of legislation by the Senate establishing a Civil Tiltrotor Advisory Committee. The Senate legislation followed a similar move by the House of Representatives establishing a tiltrotor committee on July 27, 1991. The legislation directs the Department of Transportation to appoint a commission composed

of federal agencies, state and local governments, and private industry to study the feasibility of developing a civil tiltrotor infrastructure.

In a second move, Congress decided that the $4-million FY-93 budget requested by the FAA for its Vertical Flight Program Office (VPFO) just wasn't enough. When the dust settled in early October, an additional $1.5 million had been pumped into the office; furthermore, the money is to be used for civil tiltrotor research.[48]

Something is Fishy!

The U.S. pioneered tiltrotor technology and has led its development for over 30 years, firmly establishing the vehicle proof-of-concept with flight demonstrators. The U.S. is the only country to demonstrate tiltrotor technology and currently holds a commanding lead in its applications. The current DoD V-22 Osprey program is in the second year of generally successful flight tests. With the continuation of the V-22 program, the U.S. seems assured of this overall leadership position for the foreseeable future. However, the basic technology for tiltrotors is universally known and, in both Europe and Japan, the industrial base for its application in the civil market is being developed. If the U.S. does not follow through in civil applications with the advantage it has gained with the V-22 program, then its leadership position in the international market will be in jeopardy.[49]

The Bell-Boeing Team has made several suggestions with regard to what they feel will make the V-22 program in particular and civil tiltrotor program in general a viable entity. They suggest that a cooperative industry/government team overture using innovative approaches for reducing costs is the ticket.

Such a partnership would enable cost reduction in at least four major areas:

1. Expansion of the production base beyond DOD needs through international military and commercial tiltrotor sales.

2. Incentives for investment in production efficiency to include gain-sharing

3. Streamlined procurement procedures and budgeting based on innovative and flexible manufacturing.

4. Research and technology in the manufacturing processses.[50]

One major problem still remains. American industry--manufacturers, buyers, and operators--is a "show me" industry. They must be convinced new technology is safe, reliable, economical, and maintainable before they will commit their limited investment funds in what is admittedly a business risk. The experience of a DoD development program will provide much of that confidence, but a commercial demonstration is also necessary.

If the DoD program is not continued, a civil aircraft must be developed and built independently if an American civil tiltrotor is to become a reality.

Unlike the Defense Department, the Departments of Transportation and Commerce have neither the development and procurement funds nor the organizational capability to demonstrate a civil tiltrotor program. This is despite the fact that it has been historically perceived that civil aircraft development is industry's responsibility.[51]

The answer then is that the V-22 is truly a Red Herring within a narrow overarching Dual-Use Technology definition. The definition of "dual-use" being something that has immediate defense and commercial application whether it is a

technology, a process, or a product. In this regard the program fails to represent a marriage of commercial and military goals. The V-22 meets the military mission as espoused in the JROC but fails to meet the commercial requirement for a "proven" cost effective alternative or adjunct to their profit oriented motives. In different terms, the V-22 program represents a "user-pull" based on the services' perception of deficiencies in their current weapon system but has not met the commercial equivalent of a "market demand."

What Can We Do?

Unprecedented change is the national and international byword of the decade. The new world order and the new administration are going to require that the U.S. reassess the way it has approached a lot of things. Particularly important is the way the new administration guides the country in the global market place. In order to be competitive, innovative approaches in all areas of the economic arena are going to be required. But first and foremost, it will take a team effort. There will be a requirement for some compromise by industry and DoD. Continued subscription to secular interests by Congress, industry and the Defense Department will only exacerbate the situation. With respect to dual technology, the V-22 program is a lost cause unless some fundamental changes are proffered with respect to incentives for business participation. The technology transfer will continue quite possibly to the detriment of the country. If foreign manufacturers get the jump, it is quite possible the U. S. will become an importer of the technology causing further impact on the trade deficits.

The potential for tiltrotor technology to benefit the United States makes it a

"national asset", one that has strong contributions to make in both the civil and military sectors.

When taken on the whole, it appears that tiltrotor technology offers an opportunity for the nation that should not be unilaterally decided by one federal department, or independently by the government or industry. It requires a joint national effort to align demands and cooperation to achieve the capabilities that this technology can provide.[52]

Specifically, benefits accruing from the production of civil versions of the V-22 would be felt at the industry and national level. From the industry perspective, additional tiltrotor output would lower production costs, accelerate movement along the learning curve, and eventually result in the optimized aircraft design. The foreign sale of tiltrotors would contribute favorably to the trade balance. Expanded tiltrotor production would contribute to the advancement of technology, the increased use of composite materials, and a more active supplier base for critical parts. Finally, civil V-22 derivatives such as passenger commuter aircraft, could supply this growing market segment with domestically produced aircraft.[53]

Fish or Cut Bait?

The time is now. The current administration has created an excellent environment to adapt some, all or any other innovative venues that will sustain the U.S. worldwide leadership. Failing to do so will result in:

* Further decline in the economic prosperity of the U.S. and a missed opportunity to shrink the growing trade inbalance.

* A retreat to hollow military forces of the '70's, specifically hindering the Marine Corps unique mission capability.

* An opportunity to establish a focused government and industry program that will buttress the U.S. position with respect to the foreign approach of civil-military integration.

*And finally a chance to enhance our national security posture!!

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March 1991

National Critical Technologies	DoC EmergingTechnologies	Defense Critical Technologies
Materials		
• Materials synthesis and processing • Electronic and photonic materials	• Advanced materials • Advanced semiconductor devices • Superconductors	• Composite materials • Semiconductor materials and microelectronic circuits • Superconductors
• Ceramics • Composites • High-performance metals and alloys	• Advanced materials	• Composite materials
Manufacturing		
• Flexible computer-integrated manufacturing	• Flexible computer-integrated manufacturing	
• Intelligence processing equipment • Micro and nanofabrication • Systems management technoligies	• Artificial inteligence	• Machine intelligence and robotics
Information and communications		
• Software • Micro-electronics and optoelectronics	• High performance computing • Advanced semiconductor devices • Optoelectronics	• Software producibility • Semiconductor materials and microelectronic circuits • Photonics
• High performance computing and networking • High-defination imaging and displays • Sensors and signal processing	• High performance computing • Digital imaging • Sensor technology	• Parallel computer architectures • Data fusion • Signal processing • Passive sensors • Sensitive radars
• Data storage and peripherals • Computer simulation and modeling	• High density data storage • High performance computing	• Machine intelligence and robotics • Photonics • Simulation and modeling • Computational fluid dynamics
Biotechnology and lifesciences		
• Applied molecular biology • Medical technology	• Biotechnology • Medical devices and dianostics	• Biotechnology materails and processes
Aeronautics and space transportation		
• Aeronautics • Surface transportation technoligies		• Air breathing propulsion
Energy and environment		
• Energy technologies • Pollution minimization, remediation, and waste management		* No National Critical technologies counterpart: High-energy-density materials, Hypervelocity prolectiles, Pulsed power, Signal control, Weapon system environment.

SOURCE: DoD

Seven Major DoD Science and Technology Thrusts

Global Surveillance and Communications

Satellite surveillance constellation and air and ground assets with the capacity to provide mission planning and control prior to, and during conflict.

Precision Strike

Technologies include moving target indicator and synthetic aperture surveillance radars; low-observable, fixed wing and rotary attack aircraft with all-weather, day/night navigation; and smart standoff weapons.

Air Superiority and Defense

All-weather defense against advanced tactical cruise missiles and aircraft for military forces and civilian populations. Includes frequency radars and infrared sensors in a distributed, cooperative system supported by real-time command and control with automated decision aids and positive IFF.

Sea Control and Undersea Superiority

Distributed, fixed and mobile platforms with full spectrum acoustic and non-acoustic mono- and bi-static sensors with improved submarine communications, netted together for anti-submarine and anti-mine warfare.

Advance Land Combat Vehicles

Transportable, all-weather, day/night, mobile, and lethal vehicles. Utilize signature control, advanced armor, and gun/missle systems. Lighter, more reliable and sustainable.

Computers and Electronics

Technology for training and readiness. Distributed advanced simulation and synthetic environments integrated with electronic training ranges, centers, and schools.

Technology for Affordability

Software engineering to reduce software costs and increase reliability; product and process simulators; new tools for distributed engineering practice and integrated computer-aided design and manufacturing; and flexible manufacturing techniques for prototyping and low-volume production.